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PRODUCTION FACILITIES

FOR MULTI-TURN METAL-FILM TRIMMER RESISTORS

PER SIGNAL CORPS TECHNICAL REQUIREMENTS SCS-127

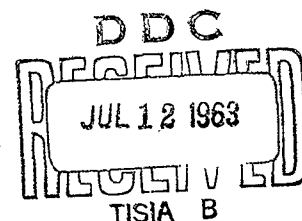
Contract Number DA-36-039-SC-86734

Order Number 19056-PP-62-81-81

QUARTERLY PROGRESS REPORT NUMBER 3

FOR THE PERIOD

JANUARY 1, 1963 THROUGH MARCH 31, 1963



UNCLASSIFIED

WESTON INSTRUMENTS DIVISION

Newark 14, New Jersey

PRODUCTION FACILITIES
FOR MULTI-TURN METAL-FILM TRIMMER RESISTORS
PER SIGNAL CORPS TECHNICAL REQUIREMENTS

SCS-127 DATED 9 FEBRUARY, 1962

Contract Number DA-36-039-SC-06734

Order Number 19056-PP-62-81-81

Specification Number MIL-R-22097B

OBJECT:

To provide production type equipment and tools sufficient to demonstrate the capability of producing 350 units per 8 hour shift conforming to the applicable specifications outlined in the contract

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JANUARY 1, 1963 THROUGH MARCH 31, 1963

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ABSTRACT:

The following outlines work accomplished and difficulties encountered during the period from January 1, 1963 to March 31, 1963.

- A. Assembly and production tooling has been completed and is sufficient to meet the requirements of the contract. Proposals to further refine some of the assembly tools have been made and are being acted upon.
- B. Quantities of parts sufficient to fabricate the pre-production samples were received. Incoming quality inspection rejected several of these components for various reasons. All of the part deficiencies have since been remedied and sufficient quantities of these parts are now available with one exception. This will be further elaborated on in the narrative.
- C. The production facilities layout has been improved and finalized. The assembly methods specification is being changed to reflect this rearrangement. Also, a formal time study is being instituted.
- D. The test equipment that is being provided by the Laboratory Engineering group for the in production and acceptance tests is complete with one exception. Formal test procedures covering this equipment is being initiated.

- E. Testing of the 300 pre-production samples by Quality Acceptance has been scheduled to start on 15 May 1963 and to be completed by the end of September 1963.
- F. Because of the delay in obtaining sufficient acceptable components from outside vendors, the 300 pre-production samples will not be completely fabricated until 15 May 1963. Work on the sub-assemblies not affected by this delay is proceeding, so that when all the components are available, the final assemblies can be fabricated in a minimum amount of time.

Similar delays in obtaining component parts required for specialized test apparatus and fixtures fabricated by Laboratory Engineering has caused a corresponding delay in completion of this equipment.

PURPOSE:

The purpose of Contract DA-36-039-SC-78926 is to:

- A. Provide 18 Engineering samples for the purpose of evaluation in the following ranges:

<u>RESISTANCE</u>	<u>QUANTITY</u>	<u>TYPE OF RESISTOR</u>
200 Ohms	6 each	Toroid
50 K Ohms	6 each	Spiral
200 K Ohms	6 each	Spiral

The above samples were submitted accompanied by test data as specified in the contract.

- B. Provide 300 Preproduction units for the purpose of evaluating the production tooling and obtaining the most suitable assembly procedures prior to the production run.

The ranges are as follows:

<u>RESISTANCE</u>	<u>QUANTITY</u>	<u>TYPE OF RESISTOR</u>
200 Ohms	100 each	Toroid
50 K Ohms	100 each	Spiral
200 K Ohms	100 each	Spiral

The preproduction run has been started and the problems encountered are covered in the narrative and data section of this report.

- C. Provide 3750 production units in the ranges outlined in the contract. This phase will be performed with production type equipment.

and a production type pilot run necessary to manufacture and test 350 units per eight (8) hour shift conforming to the applicable specifications as follows:

<u>RESISTANCE</u>	<u>QUANTITY</u>	<u>TYPE OF RESISTOR</u>
200 Ohms	750	Toroid
50 K Ohms	750	Spiral
200 K Ohms	750	Spiral
Lower than 200 Ohms and as low as possible within specifications	750	Toroid
Higher than 200 K Ohms and as high as possible within specifications	750	Spiral

The production manufacturing tooling produce the component parts and the assembly tooling for the production type pilot run have been completed.

NARRATIVE AND DATA:

Component Parts:

Pre-production Sample Parts:

All of the component parts required to fabricate the 300 pre-production units are available and fully acceptable with the following reservations and exceptions:

1. The contact supports for the triplot were machined by Weston and sent to a vendor for nickel and rhodium plating. These parts have been rejected three times due to insufficient plating and/or poor finish. At the time of the last rejection, sufficient acceptable parts were hand selected from the rejected lot in order to provide for the 300 pre-production units. New contact supports are being machined and a new vendor is being contacted in order to remedy this situation.
2. The terminal strip pins were initially manufactured by Weston facilities using a machining process. This process was economically unfeasible in production quantities. Consequently, the job was sent out to be cold headed by a vendor who could maintain the close concentricity requirements while offering a substantially reduced cost. The vendor has encountered difficulties and has not been able to provide the pin at this date. Action

is being taken by the Weston machining facilities, to provide us with a quantity of pins, so that we may fabricate the 300 pre-production units by May 15, 1963.

Item one, listed above, seriously delayed the assembly of the trimpot. This condition has been rectified as explained previously. Item two is not seriously delaying the fabrication of the trimpot, since it is part of the last sub-assembly (terminal strip) to be assembled to the unit. Work is continuing on the assembly of the 300 samples (less the terminal strip), so that when the terminal strip pins become available, the final assembly can proceed without further delay.

Unmetallized Ceramic Blank

The overall dimension of the ceramic blank has been reduced from .650 to .645 inch, and the tolerance from $\pm .005$ to $\pm .002$ inch. This was done in order to obtain the proper overall length, while maintaining a consistent optimum torque of 2 to 4 oz-in, when the trimpot final assembly was pressed together using production techniques. Since the blank cutoff facilities of Weston could not hold the $\pm .002$ in. length tolerance, the job was given to a vendor. The vendor was able to hold the length tolerance, but the process left a detrimental residue in the blank. This condition has been rectified and the blanks now meet all specifications.

Metallized Ceramic Blank

Gold terminations are used on the ends of the metallized ceramic blank. A condition of relatively high resistance has been found in the region where the gold contacts the film. The magnitude of this resistance is unpredictable. This termination resistance is not harmful, per se, in the case of a spiralled blank since it is a very small part of the total resistance after spiralling. It is harmful inasmuch as it renders uncertain the predictability of final resistance after spiralling. The formula used in predicting the spiralled resistance of a blank was derived on the basis of zero termination resistance. This in effect means that the film resistance is taken as that which would be read when connecting an ohmmeter across the blank. In actuality the blank resistance consists of an unpredictable termination resistance in series with the film resistance. Since the film resistance is the only component of blank resistance that is adjusted upward by spiralling, the final resistance may be considerably lower than predicted. The formula cannot be modified to compensate for this effect due to the random nature of the termination resistance. This results in a dropout when spiralling blanks. Work on eliminating this condition is now taking place.

ASSEMBLY:

Resistance Blanks

A semi-automatic device for spiralling metallized resistance blanks by the electrical probe method has been developed by Product Engineering. This device will be replaced by a fully automatic adjusting lathe on or about May 6, 1963. Meanwhile, spiralled blanks are being produced by the semi-automatic device.

Assembly Tooling:

The assembly tooling is adequate to produce the quantity of trimpots required by the contract. However, greater efficiency will result from improvements that are being made in the following areas:

Soldering Fixture (ST111655)

The multi-position holding fixture that is being used to hold the toroid unit terminal end cap assembly while soldering the lead wire and terminal is being modified to provide a more positive holding action.

Spiral Contact Trimpot Final Assembly Fixturing (ST111684)

Two individual holding fixtures are being used to hold the terminal and adjuster halves of a spiral contact final assembly during the phase of

assembly prior to final pressing. It is during this phase that the spiral contact is positioned on the support, and subsequently inserted into the spiralled resistance blank. A guide to keep the holding fixtures in the proper alignment is being developed in order to improve this operation.

Toroid Contact Assembly

The toroid contact is assembled onto the follower by hand, using a holding fixture developed by our Model Shop. An investigation into improving this device, or supplanting it in its entirety, is being made. The purpose of this investigation is to decrease the time and skill required for this operation.

16 Cavity Encapsulation Mould

The 16 cavity mould for encapsulating the completed triapot has been received from the vendor. This mould is in the process of being set up for use.

Inspection and Quality Control Plan Manual:

The Inspection and Quality Control Plan Manual, as outlined in Quarterly Progress Report No. 2, is nearing completion and a rough draft has been promised by the end of May.

Assembly Facilities Layout

The following pages show:

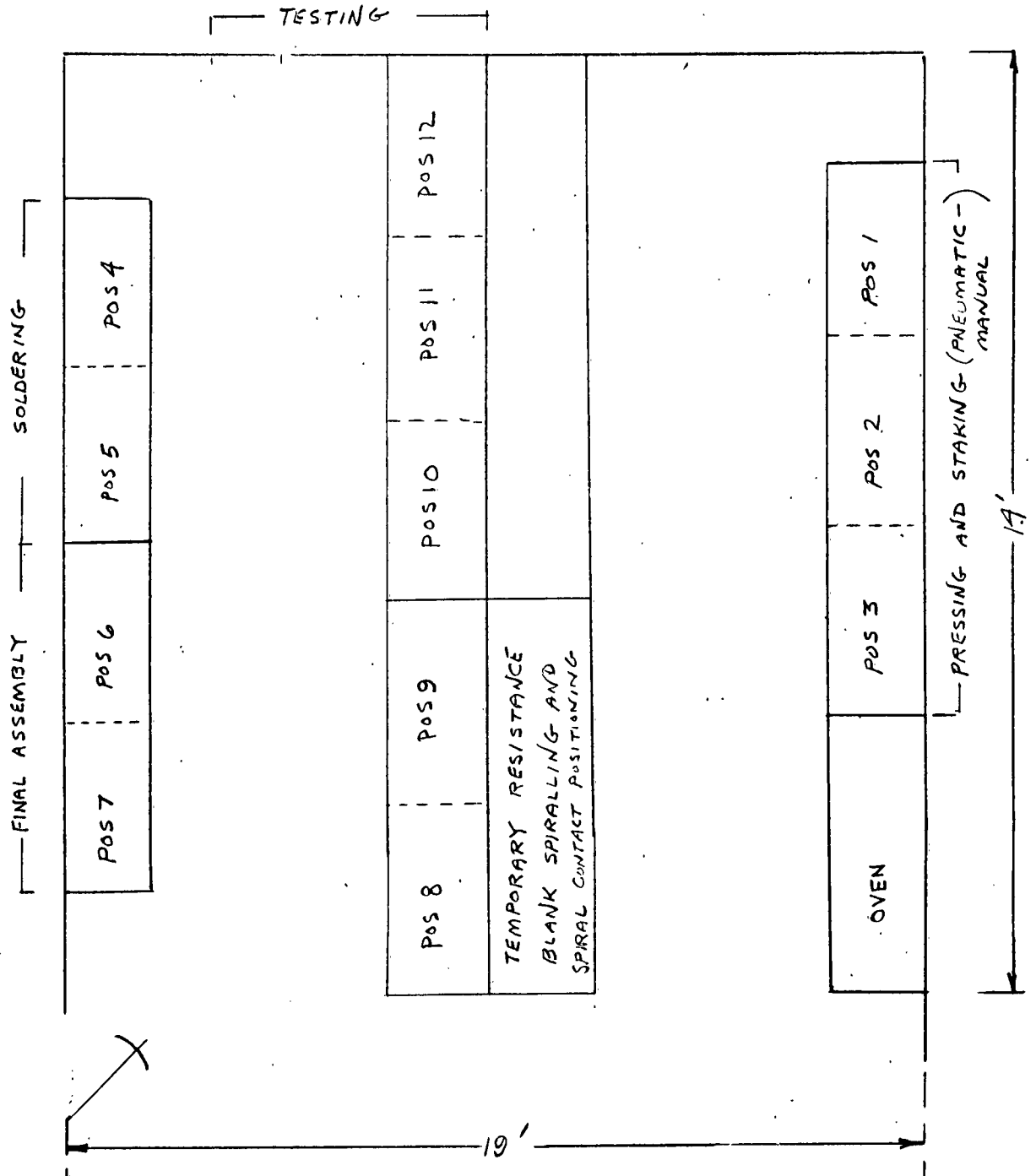
1. Floor plan

The floor plan indicates assembly and test areas, and assigns a position number to an individual work area.

2. Each position is explained in terms of

- a. Operations performed
- b. Component parts and/or subassemblies required
- c. Sub-assembly produced
- d. Tools and fixturing required.

FACILITIES LAYOUT



Position No. 1:

Operation:

Assemble terminal strip (244509)

Parts:

Center terminal (197625)

End terminal (197626)

Terminal strip (197627)

Pins (244508)

Tools:

SOC press (Mach. No. 4045)

Anvil and punch (ST 111651)

Position No. 2:

A. Operation:

Assemble toroid insulator assem-cap, terminal end
(244551 less lead wire).

Parts:

Terminal (197615)

Bearing (197630)

Cap (244201)

Insulator (244500)

Tools:

Punch and anvil (ST 111654)

B. Operation:

Assemble spiral lead screw assembly (244498 less
lead screw and lead wire).

Parts:

Terminal (197615)

Bearing (197616)

Cap (244201)

Insulator (244500)

Tools:

Punch and anvil (ST 111649)

A and B SOC Press (Mach. No. 4044)

C. Operation:

Assemble toroid adjuster assembly (244550).

Parts:

Washer (197614)

Spring (197613)

Lead screw (244549)

Adjuster molded (244503)

Tools:

Manual press (ST 111653)

Position No. 3:

A. Operation:

Press lead screw assembly on tube (244498 less lead wire but including blank). Press tube fully into cap.

Parts:

Lead screw assembly (244498 less lead wire)

Tube 25 turn spiralled (244506)

B. Operation:

Press toroid insulator assembly on tube (244551 including tube).

Parts:

Toroid insulator assem-cap, terminal end (244551)
Tube (244505)

A and B Tools:

Manual press (ST 111646)

C. Operation:

Final tube assemblies pressing - Press to applicable overall dimension with torque 2 - 4 oz-in. (197600, 197601 less lead wire, term strip, and molding; 197602 less molding)

Parts:

All tube final assemblies from final assembly area (Positions 6-7)

Tools:

Torque screw driver (ST 61291-52)
SOC press (Mach. No. 4051 and ST 111646)

Position No. 4

A. Operation:

Solder lead screw to spiral lead screw assembly (244498 less lead wire)

Parts:

Spiral lead screw assembly (244498 less lead screw and lead wire) - From position 2B
Washer (197614)

Position 4 Parts (con't)

Lead screw 25 turn (244499)

Spring (197613)

Tools:

Holding fixture (ST 111650)

Soldering iron (25 watt, 120 VAC Hexacon)

B. Operation:

Solder lead wire to toroid insulator assem-cap,
terminal end (244551)

Parts:

Toroid insulator assem-cap, terminal end (244551 less
lead wire) - From position 2A.

Lead wire (244806)

Tools:

Holding fixture (ST 111655)

Soldering iron (25 watt, 120 VAC Hexacon)

Position No. 5:

A. Operation:

Solder terminal strip to pressed final assemblies.

Solder lead wire to spiral pressed and contact
positioned final assemblies.

Parts:

Pressed toroid tube final assemblies - from position 3

Pressed spiral contact tube final assemblies after
contact positioning.

Terminal strip assembly (244509) - from position 1.

Lead wire (244806)

Tools:

Holding fixture (ST 111647)

Soldering iron (Hexacon 25 W, 120 VAC)

Position No. 6:

A. Operation:

Assemble adjuster assembly-sleeve (spiral) 244502

Parts:

Sleeve-adjuster (244504)

Adjuster-moulded (244503)

Tools:

Hand pressing fixture (ST 111683)

B. Operation:

Assembly of spiral contact tube final assembly

Parts:

Adjuster assembly-sleeve (spiral) 244502 - from
position 6A.

Spring (197613)

Washer (197614)

Lead screw assembly and tube less lead wire (244498
and tube less lead wire) from position 3A.

Insulator -cap, head end (spiral) (197605-901)

Gasket-head (197606)

End cap (244501)

Contact-spiral (197611)

Contact support (244507)

Tools:

Holding fixtures (ST 111684)

Position No. 7.

A. Operation:

Assemble contact follower assembly - toroid (244548)

Parts:

Follower - contact (244547)

Contact - wound (197633)

Tools:

Special holding and indexing fixture (supplied
by vendor)

B. Operation:

Assembly of toroid tube final assembly

Parts:

Contact follower assembly toroid (244548)

Tube and cap assembly

Toroid adjuster assembly- lead screw (244550)-from
position 2C

Washer (197614)

Spring (197614)

Insulator- cap head end (toroid) (197605-902)

Gasket-head (197606)

End cap (244501)

Tools:

Hand Operation

Position - Spiral Contact positioning and epoxy sealing

A. Operation:

Position spiral contact and seal with epoxy

Parts:

Pressed spiral contact tube final assembly
from Position 3.

Tools:

Impedance comparator
Special holding fixture

B. Operation:

Seal all units with epoxy prior to molding.

Parts:

All units prior to molding.
No tools.

Position No. 8

A. Operations:

Measure total and end resistance

Test Equip:

Decade box (T58006)

Impedance comparator (")

Rotary Apparatus (")

980 V.O.M.

B. Operation

Measure Torque

Test Equip:

Rotary apparatus and torque indicator (T58016)

Position No. 9

A. Operation

Measure effective electrical travel and linearity

Test Equip:

Chart recorder, voltage supply (T 58011)

Rotary apparatus (")

Position No. 10.

A. Operation:

Measure contact resistance variation

Test Equip.

CRO, current supply (T58008)

Rotary apparatus, decade resistor box (T58013)

Position No. 11-12

Operation:

Measure Insulation resistance, dielectric
breakdown voltage (atmospheric, barometric)

Test Equip.

Megpot

Multiposition test board (T 58009)

Switching Equip. (58017)

Vacuum Equip. (T 58015)

TEST EQUIPMENT AND PROCEDURES

Qualification Tests:

The facilities for the Qualification Tests will be
available on May 15, 1963

Acceptance Tests:

All the equipment required for the Acceptance Tests
to be performed by the Quality Control Group as outlined
in Quarterly Progress Report No. 2, is available with
one exception - the rotary cycling apparatus for the
Contact Resistance Variation Test. This unit will be
available by May 7, 1963

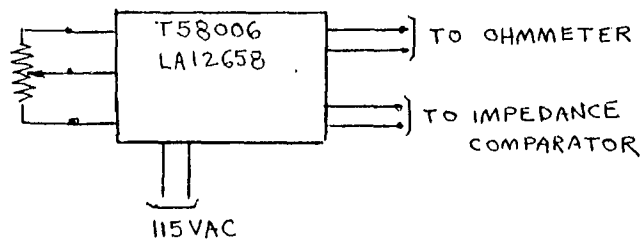
Formal test procedures for the use of the specialized
test equipment provided by Lubovatory Engineering for
various Acceptance Tests, is being prepared by Product
Engineering. These procedures will be incorporated into
the Inspection and Quality Control Plan Manual. A
sample procedure (total and end resistance is given in
the following pages.

TOTAL AND END RESISTANCE

A. Object:

To measure total and end resistance as outlined by MIL-R-22097B Par. 4.6.2 .

B. Functional Schematic



C. Synopsis:

The above equipment provides a connector which receives varmitrim and a rotary apparatus which drives the varmitrim at 120 RPM

Three switches are located on the unit. The purpose of each switch respectively is:

A. Motor power switch:

Turn power to motor on or off and reverse motor (3 positions).



B. Measurement made switch:

Provide access of resistance measuring apparatus to total resistance; or end resistance at either end of varmitrim rotation (3 positions)

c. Measurement output switch

Switches measurements between two pairs of terminals (2 position). This allows readings to be taken on an impedance comparator or ohmmeter without changing external connections. The impedance comparator is used for accurate measurements and the ohmmeter is used only to determine the position of the vamitrim contact.

d. Test Procedure

- a. Connect the impedance comparator and ohmmeter to the terminals so marked
- b. Place the vamitrim in the connector, making certain that the drive chuck blade engages with the vamitrim adjusting screw.
- c. Turn the measurement output switch to (ohmmeter)
- d. Turn the measurement made switch to either end resistance position () or ()
- e. Place the motor power switch on (forward).

The ohmmeter will show a varying reading until the vamitrim contact has reached its limits.

Shut the motor power off at this point.

- f. Turn the measurement output switch to (comparator) and adjust the decade box until a zero reading is obtained on the impedance comparator. This is the total resistance. Record it.

- g. Turn the measurement output switch to (ohmmeter) and the " mode switch to the end resistance position which produces the least ohmmeter reading.
- h. Turn the output switch to (comparator) and make the necessary adjustments to read this end resistance . Record
- i. Turn the output switch to (Ohmmeter) and the motor switch to (REV). Stop the motor when the ohmmeter change ceases.
- j. Turn the mode switch to the other end resistance position and turn the output switch to (comparator) and make the necessary adjustments to read this end resistance . Record.

CONCLUSIONS:

The following summary covers the period of January 1, 1963 to March 31, 1963.

1. The 300 pre-production samples will be assembled but not tested by May 15, 1963. Qualification testing of the 300 samples is scheduled to start on May 15, 1963 and finish by the end of September 1963.
2. An extension of the contract dates will be required.
3. Virtually all the test equipment for the acceptance testing, as outlined in Quarterly Progress Report No. 2, is available and is being tried out. Formal test procedures for the use of this equipment are being initiated.
4. A rough draft of the Inspection and Quality Control Manual will be complete by May 31, 1963.
5. The pilot line has been installed in an enclosed area and the layout has been finalized.
6. Orders for sufficient component parts for the final production run have been placed.

PROGRAM FOR THE NEXT QUARTER

1. Complete 300 pre-production samples
2. Start qualification testing of the 300 pre-production samples.
3. Complete test equipment tryout and formal test procedures.
4. Complete Inspection and Quality Control Manual
5. Improve production assembly tooling.
6. Modify the methods specification as required.

PUBLICATIONS AND REPORTS:

There were no technical articles published during this reporting period.

CONFERENCES

No conferences were held during this reporting period.

George V. Gerber:

Mr. Gerber has been with Weston (Daystrom) since 1961 in an engineering management capacity. Previously with the Archbold operation he was Chief Components Engineer and subsequently Director of Development Engineering-Components. At this location the primary field of interest was potentiometers. In his present capacity of Manager of Product Engineering he directs the engineering department servicing the film resistors and potentiometers and is the program manager for this contract.

Prior to joining Weston, Mr. Gerber had done work on ceramic to metal seals and other projects related to vacuum tubes.

TOTAL HOURS WORKED BY KEY PERSONNEL

<u>NAME:</u>	<u>TITLE</u>	<u>HOURS WORKED:</u>
Herman J. Schmitz	Mgr. Product Engineering (old)	20
G. Gerber	Mgr. Product Engineering (new)	40
Robert J. Lender	Section Chief	30
Joseph Bebel	Section Chief	50
Frank V. Effenberger	Project Engineer	500
Chester S. Kudek	Project Engineer	490
Vaughn F. Pierson	Product Engineer	80
Robert Paul	Technician	320
James P. Keelan	Dept. Head Quality Control	100
		<hr/> 1630